Clean Copy of Claims

1 . A system for measuring tape pack radii, comprising:

a tape supply reel, said tape supply reel rotating as a tape leaves said tape supply reel during a tape transfer process;

a tape take-up reel for receiving tape from said tape supply reel, said tape take-up reel rotating to receive said tape during said tape transfer process;

a first angular position transducer to measure an angular position of said tape supply reel;

a second angular position transducer to measure an angular position of said tape take-up reel;

a third angular position transducer to measure an angular position in response to movement of said tape

a processor having a Kalman filter, said Kalman filter responsive to one or both of an angular position measurement by said first angular position transducer and an angular position measurement by said second angular position transducer and also responsive to an angular position measurement by said third angular position transducer, to calculate an updated estimate of one or both of a supply radius of a tape pack on said tape supply reel and a take-up radius of a tape pack on said tape take-up reel;

a servo-controller, responsive to one or both of said supply radius and said take-up radius, to control rotation of said tape supply reel and said tape take-up reel.

2. The apparatus as in claim 1, wherein said Kalman filter further comprises:

a supply Kalman filter responsive to said first angular position transducer and said third angular position transducer;

a take-up Kalman filter responsive to said second angular position transducer and said third angular position transducer.

4. The apparatus as in claim 1, further comprising:

a capstan, said tape contacting said capstan and said capstan rotating as said tape transfers from said tape supply reel to said tape take-up reel.

5. The apparatus as in claim 1, wherein said third angular position transducer further comprises:

an encoder responsive to an angular position of a capstan.

6. The apparatus as in claim 1 further comprising:

a tape length estimator responsive to said Kalman filter to determine the amount of tape available for a record operation.

7. A system for measuring a length of tape available for a record operation, comprising:

a tape supply reel, said tape supply reel rotating as a tape leaves said tape supply reel during a tape transfer process;

a tape take-up reel for receiving tape from said tape supply reel, said tape take-up reel rotating to receive said tape during said tape transfer process;

a first angular position transducer to measure an angular position of said tape supply reel;

a second angular position transducer to measure an angular position of said tape take-up reel;

a third angular position transducer responsive to movement of said tape;

a processor having a Kalman filter, said Kalman filter responsive to one or both of an angular position measurement by said first angular position transducer and an angular position measurement by said second angular position transducer and also responsive to an angular position measurement by said third angular position transducer, to determine an updated estimate of one or both of a supply radius of a tape pack on said tape supply

reel and a take-up radius of a tape pack on said tape take-up reel for calculating said available length of tape; and

a servo-controller, responsive to one or both of said supply radius and said take-up radius, to control rotation of said tape supply reel and said tape take-up reel.

8. A method for estimating a radius of a tape on a supply reel and on a take-up reel, comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position of a capstan that rotates to transfer the tape between said tape supply and take-up reels; and,

estimating by a processor employing a Kalman filter a radius of a tape pack on said supply reel and a radius of a tape pack on said take-up reel, in response to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position of said capstan.

9. The method as in claim 8 wherein said estimating step by said processor having a Kalman filter further comprises:

responding to an initial estimate of said radius of a tape pack on said supply reel;

responding to an initial estimate of a radius of tape pack on said take-up reel; and,

responding to said first angular position measurement, said second angular position measurement, and said third angular position measurement to compute said radius of said tape pack on said supply reel and said radius of said tape pack on said take-up reel.

10. The method of claim 8 further comprising:

making said first angular measurement at a first regular time interval;

making said second angular measurement at a second regular time interval;

making said third angular measurement at a third regular time interval.

11. The method of claim 10 further comprising:

choosing said first regular time interval, said second regular time interval and said third regular time interval each to be approximately 20 milliseconds.

12. A method for estimating a length of tape on a reel, comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position in response to movement of a tape; and,

estimating by a processor employing a Kalman filter said length of tape on a reel, in response to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position in response to movement of said tape.

NEW CLAIMS

13. The apparatus as in claim 1 wherein said first, second, and third angular position transducers further comprise:

a first, second, and third optical encoder responsive to the angular position of the supply reel, the take-up reel, and the third angular position transducer, respectively.

14. A method for estimating a length of tape on one or more reels, comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position of a capstan engaging the tape at a tape path length from a respective reel; and,

estimating said length of tape by a processor employing a Kalman filter, said Kalman filter responsive to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position of said capstan.

15. The method of claim 14 further comprising:

measuring a fourth angular position of a tape tension arm; and

estimating how much tape is on a selected tape reel by a processor employing a Kalman filter, said Kalman filter responsive to said angular position of the selected reel, said third angular position of said capstan, and said fourth angular position of said tape tension arm.

16. The method of claim 14 comprising:

measuring a fourth angular position of a tape engaging member which causes a change in the tape path length as tape is unwound from and wound onto the respective reel; and

the step of estimating by a processor employing a Kalman filter includes said Kalman filter being responsive to said fourth angular position of said tape engaging member as well as the measured first, second, and third angular positions.

17. A method for estimating the amount of tape on one or more, comprising:

measuring a first angular position of a tape reel;

measuring a second angular position of a cylindrical member engaging and rotating with the tape as the tape moves along a tape path;

measuring a third angular position of a tension arm engaging the tape between said reel and said cylindrical member; and,

estimating how much tape is on said tape reel and by a processor employing a Kalman filter, said Kalman filter responsive to said first angular position of said tape reel, said second angular position of said cylindrical member, and said third angular position of said tension arm.

18. The method of claim 17 wherein the cylindrical member engages the tape to cause the tape to follow the tape path.

19. The method of claim 17 wherein the cylindrical member is a capstan that engages the tape and upon rotation causes the tape to move along the tape path.

20. A system for measuring how much tape is on a reel from and to which tape is unwound and wound respectively during the rotation of the reel as the tape is moved along a tape path, comprising:

a cylindrical member engaging the tape at a position along the tape path that establishes a tape path length from the reel, said cylindrical member engaging said tape for rotation with the tape as the tape is moved along the tape path;

a first angular position transducer for measuring a first angular position of said reel as the tape IS moved along the tape path;

a second angular position transducer for measuring a second angular position of the cylindrical member as the tape is moved along the tape path; and

a processor including a Kalman filter responsive to the first and second angular positions measured by the first and second angular position transducers for calculating how much tape is on said reel.

21 .The system as in claim 20 wherein the tape cylindrical member engages the tape to cause this tape to follow the tape path.

22. The system as in claim 20 wherein the tape cylindrical member is a capstan that engages the tape and upon rotation causes this tape to move along the tape path.

23. The system as in claim 20 further comprising:

a second member engaging the tape which causes a change in the tape path length from the reel to the position at which the cylindrical member engages the tape as the tape is moved along the tape path;

a third angular position transducer for measuring a third angular position of the second member as the tape is moved along the tape path; and

said processor calculating how much tape is on the reel in response to the third angular position measured by the third angular position transducer as well as the measured first and second angular positions.

24. The system of claim 23 wherein the second tape engaging member is a tension arm mechanism that engages tape at a position along the tape path between the reel and the cylindrical member.

25. A method for measuring how much tape is on a reel from and to which tape is unwound and wound respectively during the rotation of the reel as the tape is moved along a tape path, comprising:

measuring the amount of rotation by the reel as the tape is unwound from and/or wound onto the reel;

measuring the amount of movement of the tape along the tape path as the tape is unwound from and/or wound onto the reel, the movement of the tape measured at a position along the tape path that establishes a tape path length from the reel; and

calculating by a process that employs a Kalman filter how much tape is on the reel in response to the measured amount of rotation by the reel and the measured amount of movement of the tape.

26. The method of claim 25 further comprising:

measuring the amount of change in the tape path length as the tape is unwound from and/or wound onto the reel; and

said step of calculating how much tape is on the reel is in response to the measured amount of change in the tape path length as well as the measured amounts of reel rotation and tape movement.

27. The method of claim 25 further comprising:

h. Choosing a variable to be measured;

i. selecting a minimum and maximum acceptable measurement value of said variable;

j. selecting a maximum acceptable variance of said variable;

k. recording an individual measurement;

l. determining if said individual measurement's variance is greater than said maximum acceptable variance;

m. determining if a three sigma-interval around said individual measurement is not at least partially included within an interval from said minimum to said maximum acceptable measurement values;

g. if the determinations in steps d OR e prove true, ignoring the individual measurement and basing the current Kalman filter estimate on other measurements and on previous Kalman filter estimates.

28. A method for improving a Kalman filter estimate in a series of estimates by ignoring selected measurement values, comprising the steps of:

a. Choosing a variable to be measured;

b. selecting a minimum and maximum acceptable measurement value of said variable;

c. selecting a maximum acceptable variance of said variable;

d. recording an individual measurement;

e. determining if said individual measurement's variance is greater than said maximum acceptable variance;

f. determining if a three sigma-interval around said individual measurement is not at least partially included within an interval from said minimum to said maximum acceptable measurement values;

n. if the determinations in steps e OR f prove true, ignoring the individual measurement and basing the current Kalman filter estimate on other measurements and on previous Kalman filter estimates.

29. The method of claim 27 further comprising:

choosing said variable as an output of a transducer which responds to movement of a tape;

ignoring measurements of said transducer in the event that steps e OR f prove true, and basing the current Kalman filter estimate on other transducer measurements responsive to movement of said tape.

30. A computer-readable medium comprising: instruction and data written thereon, said instructions and data containing information for the practice of the method of the claim 25.

31. Electromagnetic signals traveling over a computer network comprising: said electromagnetic signal carrying information for the practice of the method of claim 25.

a tape take-up reel for receiving tape from said tape supply reel, said tape take-up reel rotating [as it receives] to receive said tape during said tape transfer process;

[an at least one encoder responsive to movement of said tape;]

a first angular position transducer to measure an angular position of said tape supply reel;

a second angular position transducer to measure an angular position of said tape take-up reel;

a third angular position transducer to measure an angular position in response to movement of said tape;

[a third transducer responsive to said at least one encoder;]

a processor having a Kalman filter, said Kalman filter responsive to one or both of an angular position measurement by said first angular position transducer and an angular position measurement by said second angular position transducer and also responsive to an angular position measurement by said third angular position transducer, to calculate an updated estimate of one or both of a supply radius of a tape pack on said tape supply reel and a take-up radius of a tape pack on said tape take-up reel;

a servo-controller, responsive to one or both of said supply radius and said take-up radius, to control rotation of said tape supply reel and said tape take-up reel.

2. The apparatus as in claim 1, wherein said Kalman filter further comprises:

a supply Kalman filter responsive to said first angular position transducer and said third angular position transducer;

a take-up Kalman filter responsive to said second angular position transducer and said third angular position transducer.

3. The apparatus as in claim 1 wherein said third angular position transducer [at least one encoder] further comprises:

a first encoder responsive to an angular position of a supply reel tension arm;

a second encoder responsive to an angular position of a take-up reel tension arm.

4. The apparatus as in claim 1, further comprising:

a capstan, said tape contacting said capstan and said capstan rotating as said tape transfers from said tape supply reel to said tape take-up reel.

5. The apparatus as in claim 1 [3] wherein said third angular position transducer [at least one encoder] further comprises:

an [a third] encoder responsive to an angular position of a capstan.

6. The apparatus as in claim 1 further comprising:

a tape length estimator responsive to said Kalman filter to determine the amount of tape available for a record operation.

7. A system for measuring a length of tape available for a record operation, comprising:

a tape supply reel, said tape supply reel rotating as a tape leaves said tape supply reel during a tape transfer process;

a tape take-up reel for receiving tape from said tape supply reel, said tape take-up reel rotating [as it receives] to receive said tape during said tape transfer process;

[an at least one encoder responsive to movement of said tape;]

a first angular position transducer to measure an angular position of said tape supply reel;

a second angular position transducer to measure an angular position of said tape take-up reel;

a third angular position transducer responsive to movement of said tape;

[a third transducer responsive to said at least one encoder;]

a processor having a Kalman filter, said Kalman filter responsive to one or both of an angular position measurement by said first angular position transducer and an angular position measurement by said second angular position transducer and also responsive to an angular position measurement by said third angular position transducer, to [calculate] determine an updated estimate of one or both of a supply radius of a tape pack on said tape supply reel and a take-up radius of a tape pack on said tape take-up reel for calculating said available length of tape; and

a servo-controller, responsive to one or both of said supply radius and said take-up radius, to control rotation of said tape supply reel and said tape take-up reel.

8. A method for estimating a radius of a tape on a supply reel and on a take-up reel, comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position of a capstan that rotates to transfer the tape between said tape supply and take-up reels [responsive to movement of a tape]; and,

estimating by a processor employing a Kalman filter a radius of a tape pack on said supply reel and a radius of a tape pack on said take-up reel, in response to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position of said capstan [responsive to movement of said tape].

9. The method as in claim 8 wherein said estimating step by said processor having a Kalman filter further comprises:

responding to an initial estimate of said radius of a tape pack on said supply reel;

responding to an initial estimate of a radius of tape pack on said take-up reel; and,

responding to said first angular position measurement, said second angular position measurement, and said third angular position measurement to compute said radius of said tape pack on said supply reel and said radius of said tape pack on said take-up reel.

10. The method of claim 8 further comprising:

making said first angular measurement at a first regular time interval;

making said second angular measurement at a second regular time interval;

making said third angular measurement at a third regular time interval.

11. The method of claim 10 further comprising:

choosing said first regular time interval, said second regular time interval and said third regular time interval each to be approximately 20 milliseconds.

12. A method for estimating a length of tape on a reel [available for a record operation], comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position in response [responsive] to movement of a tape; and,

estimating by a processor employing a Kalman filter said length of tape on a reel [available for a record operation], in response to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position in response [responsive] to movement of said tape.

NEW CLAIMS

Please add the following new claims:

13. The apparatus as in claim 1 wherein said first, second, and third angular position transducers further comprise:

a first, second, and third optical encoder responsive to the angular position of the supply reel, the take-up reel, and the third angular position transducer, respectively.

14. A method for estimating a length of tape on one or more reels, comprising:

measuring a first angular position of a tape supply reel;

measuring a second angular position of a tape take-up reel;

measuring a third angular position of a capstan engaging the tape at a tape path length from a respective reel; and,

estimating said length of tape by a processor employing a Kalman filter, said Kalman filter responsive to said first angular position of said tape supply reel, said second angular position of said tape take-up reel, and said third angular position of said capstan.

15. The method of claim 14 further comprising:

measuring a fourth angular position of a tape tension arm; and

estimating how much tape is on a selected tape reel by a processor employing a Kalman filter, said Kalman filter responsive to said angular position of the selected reel, said third angular position of said capstan, and said fourth angular position of said tape tension arm.

16. The method of claim 14 comprising:

measuring a fourth angular position of a tape engaging member which causes a change in the tape path length as tape is unwound from and wound onto the respective reel; and

the step of estimating by a processor employing a Kalman filter includes said Kalman filter being responsive to said fourth angular position of said tape engaging member as well as the measured first, second, and third angular positions.

17. A method for estimating the amount of tape on one or more, comprising:

measuring a first angular position of a tape reel;

measuring a second angular position of a cylindrical member engaging and rotating with the tape as the tape moves along a tape path;

measuring a third angular position of a tension arm engaging the tape between said reel and said cylindrical member; and,

estimating how much tape is on said tape reel and by a processor employing a Kalman filter, said Kalman filter responsive to said first angular position of said tape reel, said second angular position of said cylindrical member, and said third angular position of said tension arm.

18. The method of claim 17 wherein the cylindrical member engages the tape to cause the tape to follow the tape path.

19. The method of claim 17 wherein the cylindrical member is a capstan that engages the tape and upon rotation causes the tape to move along the tape path.

20. A system for measuring how much tape is on a reel from and to which tape is unwound and wound respectively during the rotation of the reel as the tape is moved along a tape path, comprising:

a cylindrical member engaging the tape at a position along the tape path that establishes a tape path length from the reel, said cylindrical member engaging said tape for rotation with the tape as the tape is moved along the tape path;

a first angular position transducer for measuring a first angular position of said reel as the tape IS moved along the tape path;

a second angular position transducer for measuring a second angular position of the cylindrical member as the tape is moved along the tape path; and

a processor including a Kalman filter responsive to the first and second angular positions measured by the first and second angular position transducers for calculating how much tape is on said reel.

21 .The system as in claim 20 wherein the tape cylindrical member engages the tape to cause this tape to follow the tape path.

22. The system as in claim 20 wherein the tape cylindrical member is a capstan that engages the tape and upon rotation causes this tape to move along the tape path.

23. The system as in claim 20 further comprising:

a second member engaging the tape which causes a change in the tape path length from the reel to the position at which the cylindrical member engages the tape as the tape is moved along the tape path;

a third angular position transducer for measuring a third angular position of the second member as the tape is moved along the tape path; and

said processor calculating how much tape is on the reel in response to the third angular position measured by the third angular position transducer as well as the measured first and second angular positions.

24. The system of claim 23 wherein the second tape engaging member is a tension arm mechanism that engages tape at a position along the tape path between the reel and the cylindrical member.

25. A method for measuring how much tape is on a reel from and to which tape is unwound and wound respectively during the rotation of the reel as the tape is moved along a tape path, comprising:

measuring the amount of rotation by the reel as the tape is unwound from and/or wound onto the reel;

measuring the amount of movement of the tape along the tape path as the tape is unwound from and/or wound onto the reel, the movement of the tape measured at a position along the tape path that establishes a tape path length from the reel; and

calculating by a process that employs a Kalman filter how much tape is on the reel in response to the measured amount of rotation by the reel and the measured amount of movement of the tape.

26. The method of claim 25 further comprising:

measuring the amount of change in the tape path length as the tape is unwound from and/or wound onto the reel; and

said step of calculating how much tape is on the reel is in response to the measured amount of change in the tape path length as well as the measured amounts of reel rotation and tape movement.

27. The method of claim 25 further comprising:

a. Choosing a variable to be measured;
b. selecting a minimum and maximum acceptable measurement value of said variable;
c. selecting a maximum acceptable variance of said variable;
d. recording an individual measurement;
e. determining if said individual measurement's variance is greater than said maximum acceptable variance;
f. determining if a three sigma-interval around said individual measurement is not at least partially included within an interval from said minimum to said maximum acceptable measurement values;
g. if the determinations in steps d OR e prove true, ignoring the individual measurement and basing the current Kalman filter estimate on other measurements and on previous Kalman filter estimates.

28. A method for improving a Kalman filter estimate in a series of estimates by ignoring selected measurement values, comprising the steps of:

a. Choosing a variable to be measured;
b. selecting a minimum and maximum acceptable measurement value of said variable;
c. selecting a maximum acceptable variance of said variable;
d. recording an individual measurement;
e. determining if said individual measurement's variance is greater than said maximum acceptable variance;
f. determining if a three sigma-interval around said individual measurement is not at least partially included within an interval from said minimum to said maximum acceptable measurement values;
g. if the determinations in steps e OR f prove true, ignoring the individual measurement and basing the current Kalman filter estimate on other measurements and on previous Kalman filter estimates.

29. The method of claim 27 further comprising:

choosing said variable as an output of a transducer which responds to movement of a tape;

ignoring measurements of said transducer in the event that steps e OR f prove true, and basing the current Kalman filter estimate on other transducer measurements responsive to movement of said tape.

30. A computer-readable medium comprising: instruction and data written thereon, said instructions and data containing information for the practice of the method of the claim 25.

31. Electromagnetic signals traveling over a computer network comprising: said electromagnetic signal carrying information for the practice of the method of claim 25.